

blocks, and transmitting, using the encoder, the at least one previously processed block of the plurality of blocks as the first predicted block.

[0018] The motion estimation information may include position information of a second block of the plurality of blocks, the second block corresponding to the first block according to a desired criterion.

[0019] The generating the reconstructed current block may include transforming, using the encoder, the residual block into a frequency domain, quantizing, using the encoder, the transformed residual block, generating, using the encoder, the restored residual block based on the quantized residual block, and reconstructing, using the encoder, the current block based on the restored residual block and the first estimated block.

[0020] The difference value may correspond to a difference in an actual band position value of the current block and an estimated band position value of the first estimated block.

[0021] The difference value may be encoded using a variable length coding scheme.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The foregoing and other features of inventive concepts will be apparent from the more particular description of non-limiting example embodiments of inventive concepts, as illustrated in the accompanying drawings in which like reference characters refer to like parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating principles of inventive concepts. In the drawings:

[0023] FIG. 1 is a block diagram of a data processing system according to some example embodiments of the inventive concepts;

[0024] FIG. 2 is a block diagram of an encoder illustrated in FIG. 1 according to some example embodiments;

[0025] FIG. 3 is a diagram of a video frame processed in the encoder illustrated in FIG. 1 according to some example embodiments;

[0026] FIG. 4 is a detailed block diagram of a sample adaptive offset (SAO) filter and an entropy encoding circuit illustrated in FIG. 2 according to some example embodiments;

[0027] FIG. 5 is a table showing the SAO type and actual band position of each block included in a video frame according to some example embodiments of the inventive concepts;

[0028] FIG. 6 is a diagram for explaining a procedure for determining a predicted band position for a band offset type according to some example embodiments of the inventive concepts;

[0029] FIG. 7 is a diagram for explaining a procedure for determining a predicted band position for a band offset type according to other example embodiments of the inventive concepts;

[0030] FIG. 8 is a diagram for explaining a procedure for encoding a SAO parameter according to some example embodiments of the inventive concepts; and

[0031] FIG. 9 is a flowchart of a method of operating an encoder according to some example embodiments of the inventive concepts.

DETAILED DESCRIPTION

[0032] Various example embodiments will now be described more fully with reference to the accompanying drawings, in which some example embodiments are shown. Example embodiments, may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, these example embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of example embodiments of inventive concepts to those of ordinary skill in the art. In the drawings, the thicknesses of layers and regions are exaggerated for clarity. Like reference characters and/or numerals in the drawings denote like elements, and thus their description may be omitted.

[0033] It will be understood that when an element is referred to as being “connected” or “coupled” to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being “directly connected” or “directly coupled” to another element, there are no intervening elements present. Other words used to describe the relationship between elements or layers should be interpreted in a like fashion (e.g., “between” versus “directly between,” “adjacent” versus “directly adjacent,” “on” versus “directly on”). As used herein the term “and/or” includes any and all combinations of one or more of the associated listed items.

[0034] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, these elements should not be limited by these terms. These elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another element, component, region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of example embodiments.

[0035] The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms “a,” “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” and/or “comprising,” or “includes” and/or “including” when used in this specification, specify the presence of stated features, regions, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, regions, integers, steps, operations, elements, components, and/or groups thereof. Expressions such as “at least one of,” when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0036] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the